INSTITUT C.D. HOWE INSTITUTE

COMMENTARY
NO. 421

A Shot in the Arm: How to Improve Vaccination Policy in Canada

Low immunization coverage in some parts of Canada is a major concern. Practical policies to improve coverage are needed.

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Commentary No. 421
March 2015
Healthcare Policy

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Vice-President, Policy Analysis

$12.00
ISBN 978-0-88806-943-6
ISSN 0824-8001 (print);
ISSN 1703-0765 (online)

The Study In Brief

Recent outbreaks of measles in many parts of Canada draw attention to the importance of vaccination policy design, especially for children. Most Canadian provinces fail to meet national immunization targets for key diseases, and coverage ratios among children in a few provinces, where data are well kept and up-to-date, are falling over time. If immunization coverage continues to fall, more vulnerable populations, such as children, the elderly, and people with medical conditions that may prevent them from being immunized, will be put at risk.

Arguably, the general societal expectation in Canada is that people will get vaccinated, but barriers to access and the complexity of the decision mean that parents without a family physician, those in low-income households, single parents and new arrivals in Canada are likely to not immunize or just partially immunize their children. Some parents may be active objectors to immunization, and policymakers must be careful to avoid alienating them or driving them away from the system. Most, however, appear not to immunize their children not because they actively object to vaccines, but because of barriers to access, complacency, or procrastination. Those parents are the focus of this paper, and we argue should be a focus of Canadian immunization policy.

In this *Commentary*, we take a particularly close look at policies in Ontario, Alberta and Newfoundland and Labrador. Alberta and Ontario are relatively large provinces with different policy approaches to vaccination delivery, one focused on early interventions and the other on making immunization decisions mandatory in schools. Both models have their advantages, but neither province has reached national vaccination coverage targets. Newfoundland and Labrador has a policy design similar to Alberta's, but some of the highest vaccination coverage in Canada.

Despite the success of Newfoundland and Labrador's vaccination policies, we do not think that there is a one-size-fits-all solution for all provinces because the characteristics of populations are different across and within provinces. That said, some basic principles of a good policy framework are explored in this paper, including the requirement for parents to make a vaccination decision, the early collection of data, access to vaccines, scope of practice, and how information is presented to new parents.

We believe that well-designed vaccination policies could reach national targets while still accommodating choice. We argue that a key policy step, in provinces where needed, is to track immunization status from birth to better identify vulnerable regions in the event of an outbreak and better remind parents of the importance of immunization. Comprehensive registries at birth could help to coordinate subsequent parental reminders to immunize, and allow health officials to provide the information most relevant to parents. Further, we suggest reforms that ensure getting immunized is as easy as possible and that new parents be strongly encouraged to make a vaccination decision.

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Vaccination has proved a valuable tool in limiting the incidence of infectious diseases, including measles, smallpox and whooping cough, among others.

But Canada's public health authorities are increasingly concerned that immunization coverage is below target in many regions. In this *Commentary*, we explore the potential reasons for below-target coverage. We then present a range of policy options for increasing coverage, including better data management and increased clarity in the decisionmaking process.

We take a particularly close look at policies in Ontario, Alberta and Newfoundland and Labrador. Alberta and Ontario are relatively large provinces with different policy approaches to vaccination delivery, one focused on early interventions and the other on making immunization decisions mandatory in schools. Both models have their advantages, but neither province has reached national vaccination coverage targets. Newfoundland and Labrador has a policy design similar to Alberta's, but some of the highest vaccination coverage in Canada.

The successes and failures of these three provinces hold lessons for the others. The lack of comprehensive and coordinated early interventions is holding back Ontario, while a more formal mandated choice framework would help Alberta. Alberta and Newfoundland and Labrador's systems of gathering comprehensive data on immunization coverage at birth provides them with a major advantage in efforts to reach vaccination targets.

A one-size-fits-all approach is unlikely to be successful in all provinces – a combination of the provincial models has been effective in other contexts and countries (NCIRS 2013; Williams et al. 2011). Further, the unique history of a province's vaccination program might make some options impractical. Our overarching recommendation is that a successful policy framework that protects a parent's right to choose should be based on a comprehensive database that tracks vaccinations as they are administered and encourages early interventions. We further endorse a formal process for compulsory, informed choice, before and upon school entry. Informed choice upon school entry, with immunizations available in schools, is potentially even more valuable in large urban areas where there is a greater migration flow and time is limited. Some smaller, more rural areas, with less immigration, might find a carefully targeted reminder approach, using a vaccination registry, sufficient. Some provinces also might consider financial incentives, which have been effective in other countries.

Newfoundland and Labrador's success suggests that, for provinces or regions with similar immigration and population levels, a public health nurse-focused model can be effective. Some of that province's policies, such as early interventions by public health nurses, would be applicable in other provinces. Scheduled reminders based on automatic tracking at birth – features of the current systems in both Newfoundland and Labrador and Alberta – and working with parents before children are born to ensure they are informed and comfortable,

The authors would like to thank the anonymous reviewers and members of the C.D. Howe Institute's Health Policy Council for commenting on this paper. In addition, this paper has benefited enormously from comments and advice from numerous health officials, researchers, and others involved with immunization across Canada, and we gratefully acknowledge their help. Any errors are, of course, our own.

could also help reduce the difficulty of making the vaccination decision.

The complex and sometimes overlapping roles and responsibilities among jurisdictions pose a number of challenges for policymakers. In general, the federal government is responsible for vaccine safety and makes recommendations to provinces on vaccine purchases, while the provinces set childhood immunization schedules and administer vaccines. Although some overlapping of the roles of the two levels of government might occur, our focus is on the provinces' responsibility to administer vaccines routinely within their jurisdictions, and on how unique models of delivery in each province play a major role in vaccination coverage ratios.

As the provinces and Ottawa consider aspects of a National Immunization Strategy, lessons from diverse provincial experiences should be shared. As well, the need for a cross-province vaccination database is fundamental, and its creation should be a priority to ensure appropriate coverage of migrants, both interprovincial and international, and to allow for better understanding of vulnerable areas. Such a registry has been suggested several times, and partial attempts have been made to create one. Given its importance, the federal government should do more to advance this policy, including possibly establishing a joint federal-provincial funding arrangement that ensures all provinces hit milestones for data collection and sharing before new blocks of funding are made available.

A Public Good

Immunization is a public good in the sense that everyone benefits when an individual gets vaccinated, including the unvaccinated. As a result, many people might not be motivated to immunize themselves or their children, and the stated benefits to society from vaccination might not be realized. When a sufficiently high percentage of a population is immunized, so-called herd immunity can develop, so that outbreaks become less likely because it is difficult for the disease to spread even if there is an initial case. By its nature, however, immunity is a local effect: several unvaccinated individuals living near one another can spark an outbreak even if almost everyone else is vaccinated. Research suggests that unvaccinated individuals tend to be found in geographic clusters, making this a serious concern (Ernst and Jacobs 2012; Smith, Chu, and Barker 2004).[1]

Vaccination is particularly beneficial for young children, for whom the consequences of later contracting an infectious disease can be severe. The Public Health Agency of Canada estimates that each dollar spent on childhood measles, mumps and rubella (MMR) immunization results in $16 in cost savings from reduced visits to healthcare providers, fewer hospitalizations and premature deaths, as well as reduced time off by parents to care for sick children (Canada 2013). Diphtheria, pertussis and tetanus immunizations of children are estimated to return $6 for each dollar spent.[2]

Vaccination coverage ratios can fall short of targets for a number of reasons. Although the patient is not normally charged for the vaccine itself, it might be costly to travel to a vaccination location or it might take time and effort to fill out forms and assess the benefits and risks. Further, the success of public vaccines over the past century means there are few visible consequences or reminders of infectious diseases, possibly leading

1 National targets are not based directly on minimum herd immunity rates, however, because of individual mobility and clustering, which raise the required coverage ratio.

2 Influenza immunizations of adults over age 65 are thought to return $45 for each dollar spent, although this is difficult to estimate given the unpredictability of influenza strains.

to declining vaccination rates, particularly among newer generations of parents. In addition, there appear to be significant misconceptions about the costs and benefits of immunization. Forty percent of parents polled as part of a study by the Public Health Agency of Canada were more concerned about the risks of immunization than they were five years ago, and a third felt children received too many vaccines (EKOS Research Associates 2011). Scientific studies of immunizations generally conclude, however, that the risks associated with immunization are limited (Institute of Medicine 2011).

Despite the public benefits of vaccinations, most provinces are failing to meet national immunization targets for key diseases, and coverage ratios in a few provinces where data are well kept and up-to-date are falling. Over the past decade, for example, coverage ratios for the full dosage of DTaP-IPV-Hib[3] and the first dose of MMR fell by more than five percentage points in Alberta (Figure 1). As immunization coverage falls, more vulnerable populations, such as children, the elderly and people with medical conditions that prevent them from being immunized, might be at risk. In 2011, the largest measles outbreak in Canada since 1995 emerged in Quebec: in 2014, measles outbreaks occurred in British Columbia, Alberta, Saskatchewan, Manitoba and Ontario, leading to increased costs in terms of physician and hospital use in addition to the impact on health.

Since immunization is a public good, there are grounds for taking policy steps to help reach immunization targets among local populations, but politicians are reluctant to restrict freedom of choice or punish parents who are anxious about their children's well-being. We believe that policy can be designed to make immunization easy and to help professionals and policymakers do a better job of presenting the benefits and risks, while protecting parents' right to choose whether or not to vaccinate their children.

Vaccination Coverage in Canada

Using information from provincial public health agencies, departments of health and other sources, we have examined immunization coverage across the provinces for five commonly recommended vaccines. But the data have limitations. Because there is no cross-provincial standard for keeping a registry, estimates of coverage are subject to considerable error, and in some cases reflect different methodologies among provinces for children at different ages, making comparisons difficult.[4] Some provinces have a full registry, and hence relatively accurate estimates; nationally and in other provinces, estimates rely on phone surveys, which have a considerable potential for error, particularly if they miss vulnerable populations.

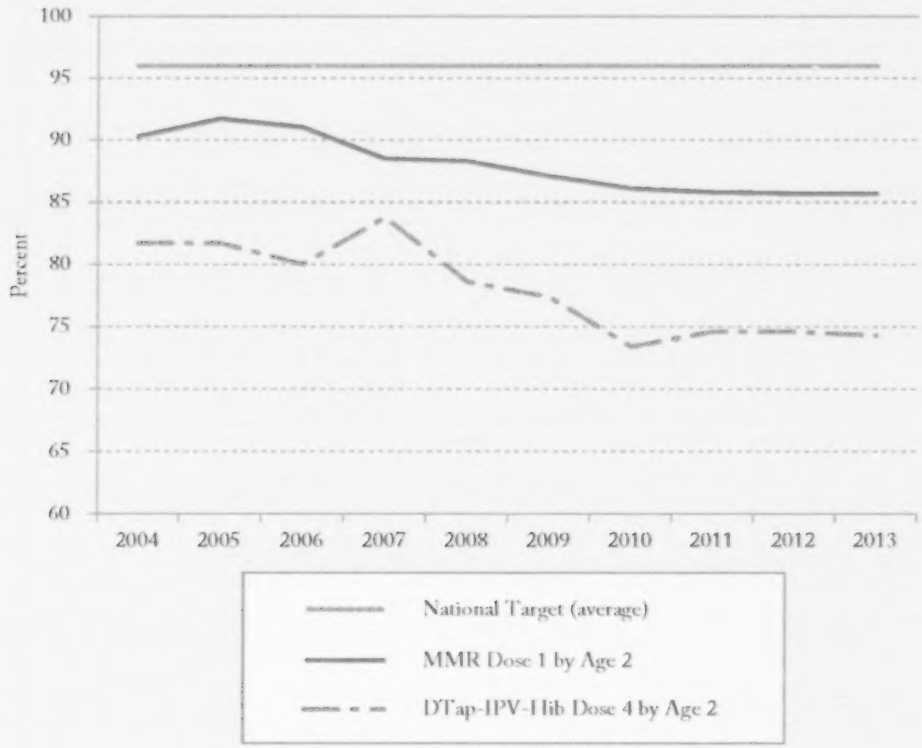
National estimates of vaccination coverage range between 70 and 95 percent, depending on the vaccine. Allowing for significant margins of error in publicly available data, we find that coverage ratios are below national targets (Table 1).[5] All

3 Immunizations for diphtheria, tetanus, pertussis, polio, and haemophilus influenzae type b are combined in a single shot in Alberta, among other places. For full protection, children require five doses at various intervals.

4 In 2003, the Panorama System was suggested as a national registry to track immunization coverage and other issues related to communicable diseases. Alberta, Prince Edward Island, New Brunswick, Nova Scotia and Newfoundland and Labrador currently do not participate in the system, while the other provinces are in the process of joining. The Panorama System is progress, as it covers the majority of Canada's population, but it is not expected to provide the data needed to identify low-immunization areas, allow for electronic recording of immunizations as administered or track adults or adult immigrants (Ontario 2014a, chap. 3, section 3.04). More needs to be done to include all Canadians and to ensure that, when Canadians move between provinces, their information is preserved.

5 These national targets were last set in 2007.

Figure 1: Immunization Coverage of Major Child Vaccines (percent), Alberta, 2004 to 2013



Note: Due to a methodological change, for the 2004–08 period, the figure shows the percentage of children, in aggregate, who are covered by age 2; for the 2008–13 period, it measures the percentage of children who have received their final dose by age 2 but without the potential upward bias in the aggregate data recorded from 2004–2008.

Source: Alberta Interactive Health Data Application.

provinces are below national targets in at least two categories, and five (Alberta, British Columbia, Manitoba, New Brunswick and Nova Scotia) are below targets in all categories for which data are available. Importantly, the data in Table 1 are province-wide results, and do not speak to local and community-level results that are necessary for herd immunity. High immunization coverage in some regions might be overshadowing low coverage in others, thereby causing policymakers to look over optimistically at province-wide results. We look at regional data in the next section.

The Cause of Missed Vaccination Targets and Low Coverage Ratios

Several reasons have been suggested for today's low vaccination coverage ratios. In particular, the rise in concerns over vaccine side effects, led in part by prominent public figures, and unfettered

Table 1: Immunization Coverage, by Province, Percentage of Target Population

Region	DTaP/IPV/HIB (all doses)[a]	Measles, Mumps, Rubella[a]	Varicella (chicken pox)	Pneumococcal conjugate	Meningococcal C conjugate
	(percent of target population covered)				
Alberta (age 2, 2013)	74.2	85.2	84.0	83.0	81.2
British Columbia[b] (age 2, 2013)	74.0	86.0	83.0	84.0	86.0
Manitoba (age 2, 2010)	72.6	86.6	80.1	66.9	70.5
New Brunswick (on entering school, age 4 or 5, 2012/13)	78.0	69.3	N/A	N/A	75.7
Newfoundland and Labrador (age 2, 2011/12)	96.6	95.5	96.2	96.1	96.5
Nova Scotia (age 2, 2008)	82.4	66.4	N/A	79.5	57.6
Ontario[c] (age 7, 2011/12)	82.3	90.9	75.0	96.9	72.0
Prince Edward Island (age 2, 2008)	81.0	79.0	93.0	81.0	93.0
Quebec (age 2, 2012)	85.0	83.9	92.0	93.1	94.4
Saskatchewan (age 2, 08/09)	78.9	79.3	89.3	77.3	89.7
Canada (age 2, 2011)	89.6	95.2	88.6	76.5	80.5
National Targets (2005)	95.0	97.0	85.0	90.0	97.0

Note: Each province collects data differently, making perfect cross-province comparisons impossible: coverage might be better because of a more successful program or because of incorrect data. Coverage rates refer to the number of children who have received the correct number of immunizations at the given age by that province's vaccination schedule. Importantly, at least by their own estimates, almost all provinces appear to be below national targets for coverage.

a In cases where some provinces give a combined vaccination and others gives individual shots, for comparability we averaged the coverage for the individual shots.

b VCHA statistics not included due to incompatibility of survey methods.

c For Varicella, 2011 measure of five-year olds is used to avoid switch to two-dose system.

N/A Antigen is not on provincial immunization schedule for that age.

Sources: Alberta 2014; Alberta Health Services 2014; BC Centre for Disease Control 2014; Canada 2014; Dummer et al. 2012; Institut national de santé publique du Québec 2009; Lim, McIntyre, and Wilson 2013; Manitoba 2011; Morrison 2012; New Brunswick 2013; Newfoundland and Labrador 2013; Sun Country Health Region 2009.

access to numerous conflicting and confusing online information sources, are often highlighted. Another possible reason is complacency among parents: the astonishing success of vaccines has almost eliminated the visible reminders of their importance, and absent cases of measles or whooping cough among children, it is easy to forget the benefits of immunization. Because the benefits of immunization are so dramatic, healthcare workers historically have done little to market vaccines to the public, believing they would speak for themselves.[6]

As well, many parents intend to immunize their children, but do not complete a full vaccination schedule. In Alberta, for example, roughly 92 percent of infants receive the first of their four DTaP-IPV-Hib doses, but only 73 percent receive the fourth (Alberta 2012). The reason for this failure to complete the regimen could be an increase in parental commitments, particularly on the part of parents who have returned to work after their maternity or paternity leave. Of additional concern is regional variation in vaccination coverage: since infectious disease outbreaks, by nature, begin regionally, some areas are at a greater risk of an outbreak than others (Figure 2).

Another reason for low vaccination coverage ratios is that some parents free-ride on the diligence of other parents in getting their children vaccinated, which allows them to benefit from herd immunity while ignoring the societal harm of their decision. But parents who believe they can be complacent about immunization because they think herd immunity will protect their children might not understand the level of regional variation and the potential for outbreaks even if average coverage is high.

Yet another reason for low coverage ratios is that vaccination is costly, not in terms of the administration and supply of vaccines, which usually are covered by provincial health insurance systems, but in terms of the time and resources parents might have to spend learning more about a vaccine, travelling to a vaccination centre or physician's office. There also might be barriers to access, such as clinics' limited opening hours or the lack of a local clinic, which could mean that the parent might need to take time off work.

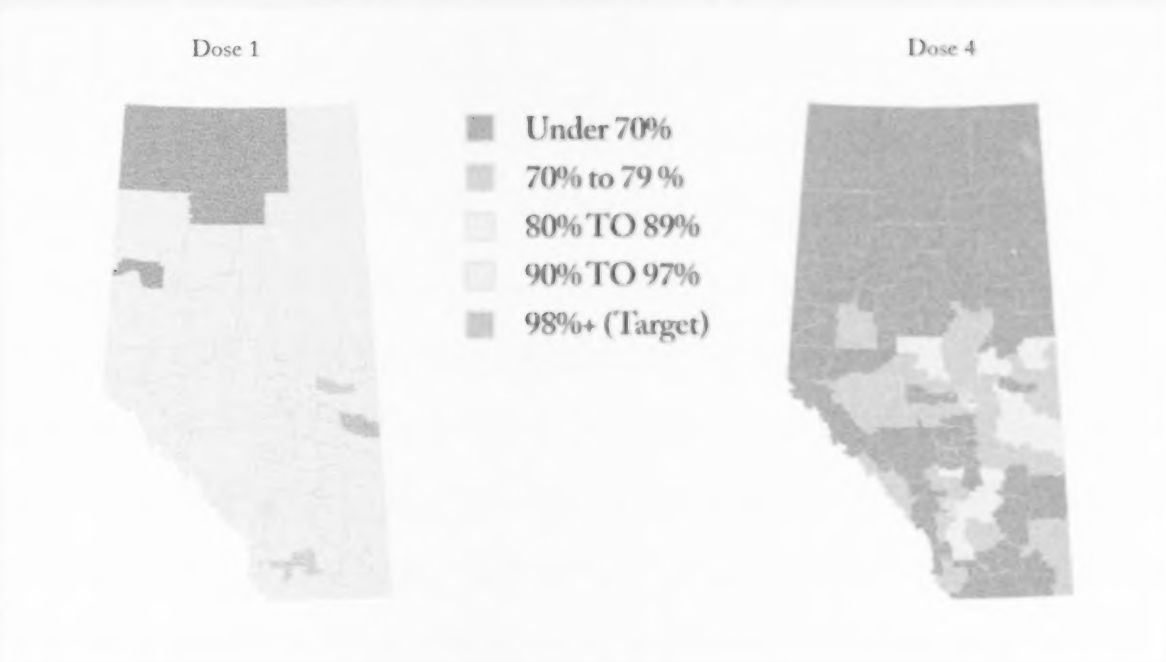
Society's expectations, as reflected in vaccination policy design, also matter. If parents feel they are expected to immunize their children because that is what their peer group does or what they feel the rest of society does, then there is considerable pressure to conform. Such pressure, moreover, can vary widely across communities and regions, which could explain some of the clustering of vaccine hesitancy (Ernst and Jacobs 2012).

The immunization decision is also an easy one to delay, which can lead many parents to fail to immunize their children even if they had intended to do so. As more time passes and their child shows no signs of major illness, parents might become even less inclined to immunize when the opportunity arises. Making immunization the default choice – in other words, absent action, a child is routinely immunized unless the parents choose to exempt the child from immunization – therefore can be a powerful incentive for parents to have their children vaccinated (Opel et al. 2013).[7]

6 Although understandable, the reality is that, absent clear messages from healthcare workers – who themselves have low coverage ratios for the annual influenza vaccination and sometimes are vaccine-hesitant – the public in some cases has turned to anecdotal or incorrect information about the effectiveness and side effects of vaccines, information unsupported by the evidence (Institute of Medicine 2004).

7 A similar problem arises in pension plan design, where policymakers have often chosen to enforce that in the absence of employee action, a fixed amount of money is set aside as saving. If there is a default choice, one that appears preselected, then individuals are likely to take it.

Figure 2: Coverage Ratio for DTaP-IPV-Hib Vaccine in Alberta, Dose 1 and Dose 4, 2013



Source: Alberta Health (2013).

Finally, the parents' immunization decision requires them to compare distant probabilities and uncertain outcomes. Thus, when information is presented, who presents it and how it is presented can make a significant difference to how easy parents find it to make the decision. The decision comes at a time when new parents, especially first-time parents, are already overwhelmed with other considerations and immediate parenting tasks. In addition, the benefits of vaccination occur well into the future, whereas the potential side effects are immediate. Parents, even highly educated ones, also can be overwhelmed by the cacophony of voices making claims about the safety or danger of vaccines. Unfortunately, many of these sources – which include the Internet, other healthcare providers and friends – can be unreliable or offer misleading information.

When a doctor or nurse makes a recommendation, however, parents take it seriously: a survey found that 89 percent of Canadian parents usually followed the advice of a child's doctor or nurse regarding immunizations (EKOS Research Associates 2011). Ensuring parents have access to reliable information as early as possible, from sources they can trust, is essential to expanding coverage. Much commendable effort has gone into determining the best ways for healthcare providers and other public sources to present information to patients (see, for example, Derban et al. 2013;

MacDonald and Finlay 2013; Ontario 2014b). It is important to make sure these strategies are adopted and revised and updated as more research is done into the most effective methods and techniques.

In essence, parents might lack good information to make the vaccination decision, and sometimes the decision is based on factors such as the timing of the costs and benefits, how the choice is framed, the context of the decision, and how information is presented. Given the broad medical consensus that vaccination is a good idea, policymakers should design better ways to express the benefits to parents who feel ill-prepared to make the immunization decision, as well as encourage those who might forget or procrastinate, while maintaining their freedom to choose not to vaccinate their children.

Characteristics of the Unvaccinated

A 2011 survey (EKOS Research Associate 2011) found that those who were most likely to feel that vaccines were unsafe were families without a family doctor, families with low household income, families with children born outside Canada and individuals under age 35. These results suggest that underlying socioeconomic, cultural and religious factors might be driving concerns about vaccines among those with children born abroad and those who might have difficulty accessing the healthcare system due to language or other challenges such as socioeconomic status. Other studies have found that many new immigrants – women, in particular – were not vaccinated against some infectious diseases (Greenaway et al. 2007). Further, the trend among young adults is troubling, and might be related to the prior successes of vaccination programs and a lack of awareness of these risks today.

A study of the Edmonton Capital Health Region (Zhang et al. 2008) found that factors associated with increased likelihood of immunization included having an older mother, having fewer siblings and being delivered by Caesarean section. The same study found that factors associated with decreased likelihood of immunization were marital status as a common law or single parent, the presence of a midwife at delivery and being a recipient of general welfare or a provincial healthcare premium subsidy. The association of decreased likelihood of immunization with having a delivery performed by or with the assistance of a midwife is intriguing. It might suggest that mothers who have general reservations about the medical establishment, and prefer more natural forms of interventions, are attracted to midwives in particular. It also might suggest that midwives are not sufficiently included in the vaccination process, and so are not in position to support the immunization decision effectively.

Research in the United States (Smith et al. 2004), differentiating between incomplete immunization and total refusal of immunization, has found that children with incomplete immunizations tended to be black, have a younger unmarried mother, have a mother without a college degree and live near the poverty level. Children who were completely unvaccinated, in contrast, tended to be white, male, have a mother who was married and had a college degree and live in a household with annual income over $75,000. The US data suggest that vaccine-hesitant parents fall into two distinct groups: the partially vaccinated, who are generally individuals in challenging socioeconomic circumstances; and the completely unvaccinated, who are generally well-to-do and well-educated individuals.

Differences between households with incompletely and completely unvaccinated children suggest that different interventions might be effective in encouraging immunization in each group. Families in the first group – particularly immigrants and low-income families – might be interested in immunization, but are more likely to have trouble accessing healthcare. For them, reducing barriers to access – such as opening hours and location of clinics or doctors' offices, language difficulties, and transport costs – would be an important way to increase vaccination rates.

From these findings, we identify three general kinds of parents who do not immunize their children. One is religious or ideological-objector parents, who are adamant about refusing immunization and whose children are likely to have received no vaccines at all. These parents are hard, if not impossible, to target with policy in the short run.[8] Since they make up a relatively small proportion of the population, however, their inclusion might not be necessary to achieve Canadian immunization coverage targets.

Another kind is vaccine-hesitant parents who might feel ill-equipped to make the decision to vaccinate their children or are uncertain about what is best. Their children might have received some, but not all, of their immunizations or they might be completely unimmunized. The vaccine-hesitant also include unconvinced objectors, who might be actively seeking more information. These parents are an important target for policy, but must be approached carefully to avoid alienating them or driving them away from the system. Research on effective messaging and the delivery of clear, reliable information to these parents is essential, as are methods of early interventions.

The final group is free-riders – parents who are broadly supportive of vaccines, but who, for reasons of time, energy or complacency, do not see that their children are fully immunized. These parents are ideal candidates for policy interventions: if the immunization process can be made a bit easier and the failure to immunize a bit more costly, they are likely to immunize.

We believe that good policy should focus on the second and third of these groups.

Vaccination Policy Design in Alberta, Ontario and Newfoundland and Labrador

Alberta and Ontario have taken very different approaches to child immunization policies. Alberta has a local-nurse-driven model that focuses on encouraging parents to immunize as much as possible. Ontario, in contrast, has a family-physician-led model that focuses on hard deadlines for parents to decide whether to immunize, such as when their child enters school. Like Alberta, Newfoundland and Labrador has a nurse-led model that focuses on early and regular interventions to inform the vaccination decision; the province has been particularly successful in meeting immunization coverage targets, making it a valuable source of lessons.

Alberta's Model: Targeted Encouragement and a Centralized Immunization Program

In Alberta, all routine infant immunizations are done by registered nurses at one of over 100 Community Health Centres operated by Alberta Health Services. Physicians are permitted to administer vaccines, but cannot do so as a billable service, a move implemented to reduce overlap in administering vaccines and to make data collection more consistent (Keelan 2008). An immunization record is created for any child born in a hospital, and a Healthy Beginnings nurse is in touch with the parents shortly afterwards to discuss health services, including the importance of immunization, and to arrange a visit within the first 14 days. If the infant is not immunized within two months, the

8 As we discuss later, parents in Ontario must request an exemption based on religious or conscientious objections to have their children attend school without being vaccinated. On this basis, the number of exemptions rose between 2008 and 2012, but it remains relatively low, at only a few percent of the population (Lim, McIntyre, and Wilson 2013).

parents are called or sent a letter to remind them. Up to three calls are made if the initial attempt to reach the family is not successful. A refusal to immunize is recorded in the registry.

Results

Alberta's nurse-led practice of administering and recording all infant immunizations exclusively in Community Health Centres gives the province a comprehensive registry, with high-quality data. Because the same entity is responsible for administering vaccines and collecting data on them, Alberta has what is essentially a full registry of immunization records. One notable exception is migrants from other provinces and abroad, who might not be entered into the system.

Alberta's vaccination program offers lessons on how to administer immunizations and how to deliver information to parents, combined with a robust list of places and healthcare professionals administering vaccines. Given the importance of structuring the message and information to convince parents to immunize, this can provide a significant advantage. The Alberta system effectively engages with parents immediately after childbirth to ensure immunizations are done early, and its system of Community Health Centres makes it easier to track coverage and encourage immunization.

Alberta's program, however, has not achieved national target rates of immunization coverage. In 2007, the province embarked on a ten-year plan to bolster immunization coverage ratios, but at present rates of declining vaccination coverage, it is highly unlikely that the province will hit its targets by 2017. Although good data and tracking of vaccination coverage allow Alberta to make timely and early interventions, many busy or hesitant parents are not getting their children fully vaccinated. Alberta's system also might be underperforming because of gaps in its reminder system after the first dose of a vaccine, or because of challenges in booking appointments for later doses once parents have returned to work. As well, its system of reminders might not create the perception of immunization as the default behaviour; since Alberta's policy framework makes it relatively easy to avoid giving consent or refusal, parents might be more complacent. In addition, Alberta's program design is not tailored to reach certain groups, such as new residents of the province.

Ontario: A "Mandated Choice" Model

In Ontario, immunizations normally are given at the office of one's primary care provider. Doctors, nurses and midwives can give immunizations, although midwives generally do not play a significant role because post-partum care ends before the initial set of immunizations at eight weeks. Although Ontario's vaccination schedule for newborns begins at two months, and many parents begin to vaccinate their children at that time, data are not officially recorded until a child enters school.

Ontario's *Immunization of School Pupils Act* (IPSA) and *Day Nurseries Act* (DNA) create a mandated choice model[9] whereby parents must either provide proof that their child is immunized or submit a form requesting an exemption, which, under the ISPA, must be witnessed by a commissioner of oaths, notary public or justice

9 In the health policy literature, Ontario's vaccination model is often referred to as a mandatory vaccination model (Walkinshaw 2011). We believe this is a misleading characterization, however, as it implies choice is not permitted, which is incorrect. As we explain below, we believe a more accurate description of the policy framework in Ontario is one of mandated choice.

of the peace.[10] If the parents do neither, the child is subject to suspension from school, although not from a nursery. The exemption can be based on religious concerns or conscientious objection, broadly defined, meaning parents need not show particular evidence of any given objection. Unfortunately, data on conscientious objection rates are available only for a few years, making it difficult to study exemption trends or the motivation behind them. Each regional public health unit may decide exactly how it carries out the process, including how many reminders are sent before a suspension notice is issued.[11]

Results

Despite its mandated choice model, Ontario still misses national immunization targets and contains geographic pockets where herd immunity thresholds are not met. In Ontario, parents keep a paper-based record of childhood immunizations. When the child enters elementary school, these records are submitted by school officials to a central database. This means that information on immunization is documented late in childhood, with little ability to track unvaccinated children prior to entering school, so that a large group of preschool children could be at risk of contracting an otherwise preventable infectious disease.[12] Further, the onus is on parents to keep the records. Moreover, if records are misplaced, a child might be given duplicate vaccinations.

Ontario's system of requiring immunization or opting out provides a substantial incentive to immunize in schools, and can be inclusive of young migrants because of mandatory school attendance. An obvious concern about the system is that many children might not be immunized until they reach school age. Indeed, data from Toronto show that, at the beginning of the 2010–11 school year, only 75 percent of children in elementary school were fully immunized, although coverage increased to 95 percent after two reminders and a suspension order had been sent out. After 10,533 students were suspended, for an average of five days, the final coverage rate was 97 percent (Toronto 2012). Follow-up of a relatively small number of parents is missed if the family moves between school districts in the year.

The Toronto Medical Officer of Health argues that the requirement to choose to immunize in school is demonstrably effective given the higher immunization coverage with respect to the six vaccines under mandate (Toronto 2012). A concern about the mandated choice model is that its perceived severity might alienate some parents, arousing opposition to immunization in general.

Elements of Ontario's system also hinder immunization coverage. The lack of automatic enrolment in the system at birth means it is difficult to encourage early interventions, potentially leaving infants vulnerable. The system is also more likely to miss children who do not have a family physician and who are already less likely to be immunized. Further, having to be vaccinated in physicians' offices is cumbersome, especially for busy parents who must struggle to get time off work. And the longer parents go without vaccinating their children, the less likely they might be to choose to vaccinate upon school entry.

10 A restricted set of vaccines is enforced under this legislation, and the list was expanded in 2014 to account for new dose requirements for tetanus, diphtheria, polio and mumps, and new vaccines for diseases such as whooping cough, chickenpox and meningococcal disease. The ISPA applies to private, public and Catholic elementary and secondary schools, while the DNA applies to licensed nursery schools.

11 A similar requirement, although for different vaccines, applies in Manitoba and New Brunswick.

12 New Brunswick also collects data on entry to school, and Manitoba does so exclusively for measles.

Ontario's lack of a centralized database of who is administering vaccines also makes it difficult to undertake trials of new methods of working with parents on immunization, and parents cannot be reminded easily of the need to immunize until and unless their children are in school. Students who are home schooled are therefore at particular risk of being missed by the system. These students might be at greater risk of not being immunized in any case, and studying immunization coverage in these populations can be difficult.

Newfoundland and Labrador: Non-Compulsory, Informed Choice

Like Alberta, Newfoundland and Labrador has a nurse-led model whereby, upon birth, information is entered into a database and a follow-up appointment is scheduled with the new parents in the following weeks. The public health nurse gives full information about the vaccination decision to the parents, and requires written consent (or refusal) to schedule an appointment for the first phase of the immunization regimen. It is a process of informed consent, meaning the nurse must explain the purpose, risks and side effects of the procedure, and provide an opportunity for questions. If parents are hesitant, the nurse will follow up later and answer any further questions. Written consent is required at the beginning of the immunization schedule, which covers immunizations until the age of two; written consent must be renewed again at kindergarten and once more for grades four, six and nine. Parents who do not submit consent forms are followed up, but there are no penalties for not returning the written forms.[13] The province's approach is to "take every opportunity," meaning to ask and offer vaccines at many different times, even if doses have been missed before.

Results

Newfoundland and Labrador has some of the highest vaccination coverage ratios in the country, and the province meets national targets. The advantage of the nurse-led model is that it has one point of contact for parents, with notable expertise and specialization in delivering messages and information. This also allows data to be kept in a comprehensive way. Public health nurses are well known in their communities, and often the nurse who provides the early visit to new parents also administers the vaccine.

In the province's eastern health region, which includes the largest city, St. John's, family doctors also administer vaccines. This suggests that some tailoring of approaches to cities, as opposed to rural areas, might make sense, since what works in smaller communities might not always translate into success in larger urban areas.

The Australian Vaccination Model

Other countries have also struggled to meet immunization targets. Particularly interesting is Australia, which had issues with vaccination coverage in the mid-1990s and chose to dramatically reform its policies to encourage more public vaccinations. Australia's system now includes formal financial incentives as well as built-in reminders and encouragement to immunize. The Australian Childcare Allowance, for example – similar to Canada's Universal Child Care Benefit – is partly conditional on the child's being immunized, as is a bonus Maternity Immunisation Allowance. Doctors are also given financial incentives to immunize infants, and when children reach school they are required to show evidence of immunization (Australia 2013). As part of a larger

13 Similar to other provinces, in Newfoundland and Labrador, unvaccinated students may be removed from school in the event of an outbreak.

package of reforms, Australia also put in place the compulsory choice of vaccination upon school enrollment.

Since these programs were put place, Australia's immunization coverage has improved dramatically, exceeding 90 percent for all recommended vaccines (Australia 2014). Australia has also had a fully operational national immunization registry in place since 1996, which has greatly improved its ability to track data and design the appropriate interventions for vaccine-hesitant parents. The success of Australia's system offers important lessons for Canadian policymakers, although it is not clear that Australia's changes could be applied to Canada's more decentralized system of vaccination delivery.

How to Improve Vaccination Policy

Immunization policy must carefully break down the many facets of the parental immunization decision to support sound decisionmaking. Where the system interacts with parents, policymakers must consider the larger framework in which vaccination decisions are made, and determine if interactions are working to ensure parents are in the best position possible to help their children.

Unlike Newfoundland and Labrador's system, neither Ontario's nor Alberta's vaccination program has been successful in hitting vaccination targets. All three models have good elements that, with some improvements, might combine to produce a vaccination framework that moves closer to desirable coverage ratios and more comprehensive levels of herd immunity. We believe that other provinces would benefit by looking at the strengths of each of the three models and then improving upon them.

The nurse-led vaccination programs in Alberta and Newfoundland and Labrador gather comprehensive data shortly after birth, and can intervene early and tailor the messaging of information provided new parents. Ontario's program requires parents to make a vaccination decision upon school entry, enforced with the threat of suspension from school, and makes avoiding vaccination more difficult. Taken together, these general characteristics should allow for a desirable vaccination policy framework that could boost vaccination coverage.

Immunization registries should start at birth. A national system that allows public health authorities and immunization providers to track immunization status would be ideal for increasing coverage and responding to outbreaks. Past efforts along these lines have not succeeded, however, so a robust system of provincial data reporting that can be shared might be a necessary compromise. Such a system would need to capture interprovincial as well as international migrants. The federal government could play a facilitator role, with a block-funding process that renews itself only when all provinces have met the requirements at predefined stages en route to a cross-provincial database. Such a database should also allow immunization providers in each province to input the vaccinations they provide immediately, to ensure that information is up to date and comprehensive.

Specific Lessons for Ontario, Alberta and Other Provinces

A review of the vaccination policy frameworks in Ontario and Alberta leads to us to make some straightforward recommendations on how to improve the key weaknesses in each province's vaccination frameworks.

Ontario

A child's immunization status is only tracked upon entry to school (around age four or five). As such, there are limited early opportunities for public health authorities, beyond a family physician or pediatrician, to support parental vaccination decisions or make a targeted response to an outbreak among infants. Instead, children should be entered into an immunization directory

at birth. Ontario should also consider how Alberta and Newfoundland and Labrador use the home visit of a nurse not just to deliver information on the benefits and risks of immunization but also as a way to track immunization status and vaccine-hesitancies early. A nurse-led model might expand the opportunities for busy parents to get an appointment at a convenient time, and tailor information to parents, which busy family doctors might not have the time to do.

That said, a nurse-led model could be expensive to scale up in large cities to meet patient demands. One option might be to increase the role of midwives: similar to Alberta's Healthy Beginnings nurses, midwives also meet with parents both before and after birth, and could help disseminate information and advice. Any such step would require, however, that midwives have sufficient information to give the best possible advice.

Ontario could also benefit from offering more immunization clinics in schools. At the moment, students are told they need immunization in school, but often must go to a clinic with their parents to be immunized. If one reason for insufficient immunization is difficulty of access due to clinic opening hours or transport availability, such a step could be a way to reduce this constraint.

Alberta

Newfoundland and Labrador's approach to immunization appears to be more successful than Alberta's, although the two systems are reasonably similar. Alberta's good success with early vaccination doses but poor results on completing the full schedule suggests that procrastination or challenges in accessing later vaccinations are critical issues.

We also wonder if Alberta's high level of in-migration and the challenges of scaling up a nurse-led model in densely populated cities help explain some of the differences between the two provinces. Aspects of the nurse-led model might be more effective in smaller communities than in larger cities, stemming from the prominent community role that nurses play in rural areas. Newfoundland and Labrador's small population also might be an advantage, making it easier for policymakers to track individual communities and respond quickly and specifically to concerns as they arise; it can also be easier to create a strong social norm or societal expectation in a smaller population. Alberta has a particularly good data-collection process, but there is room for improvement.

In contrast to Newfoundland and Labrador, Alberta does not require written consent or refusal from parents. Doing so would help formalize the expectation of making a vaccination decision and potentially increase the sense that getting immunized is the default choice. This could be combined with the need to provide proof of having spoken with a public health nurse or physician about the risks and benefits of vaccination. Ontario goes a step further by requiring notarized refusal forms and enforcing a vaccination decision on school entry with threats of suspension. Alberta's lack of a formal mandatory choice framework makes it easier to remain unimmunized.

We believe that Alberta should consider adopting a model that mandates informed choice upon school entry or earlier. This means including enforcement mechanisms to encourage parents to decide one way or another. Such mechanisms could involve requiring written consent or refusal in infancy and again upon entering school, with proof of having spoken to a physician or nurse. Stricter measures would be financial penalties, similar to the Australian model, or the threat of suspension, as in Ontario.

General Lessons

Despite the success of Newfoundland and Labrador's vaccination policies, we do not think that there is a one-size-fits-all solution for all provinces because the characteristics of populations are different across and within provinces. That said, the geographic and population characteristics of Newfoundland and Labrador are similar to those

in other Atlantic provinces, and we think those provinces should consider moving toward a similar nursing-led model. Family doctors often have significant demands on their time, which prevent them from tailoring messages to vaccine-hesitant parents and regularly following up with them. They also might have limited office hours that conflict with patient availability.

As efforts to boost immunization coverage increase, we believe that both Ontario and Alberta should consider a suite of options to improve the framing and messaging of the vaccination decision. The person parents speak to should have received formal training on how best to present the information to make a clear recommendation.[14] Effectively tailoring messages to vaccine-hesitant parents, based on individual characteristics, could help reach some parents. The basic principles of the approach are simple: follow-up, communication and understanding. With each follow-up, public health officials should try and identify the parents' implementation intention and, if they refuse immunization, their reasons for doing so. Health officials should also record this information for tailored responses. Further, following the Australian model, upon receiving their provincial child benefit cheques, parents could be reminded of the benefits of immunization as well as where they can go to get their children immunized.

Behavioural economic studies show that negative messaging that focuses on the risks and consequences of infectious disease can be ineffective in helping parents make the vaccination decision. Although there is insufficient evidence to draw firm conclusions about the best way to structure information about immunization, positive messaging – for instance, asking parents if they want their child to have the same health advantages they themselves have had, or emphasizing the benefits for other children – might be a better approach.[15]

Messages that are effective at reaching one group might be ineffective at reaching another, or even counterproductive (Nyhan et al. 2014). For example, the personal experiences of older mothers who might have personally experienced or witnessed an infectious disease might be effective when talking to younger mothers. Other groups, based on age, ethnicity or socio-economic background, might respond better to messages that emphasize other aspects of the vaccination decision. Given the importance of peer groups in decisionmaking, messages could also be tailored to the community characteristics of vaccine-hesitant parents via social media and online new mothers' groups.

It is also important to reduce the costs and barriers – such as the operating hours of clinics and doctors' offices, the location of clinics, language difficulties and transport costs – that make it difficult or impossible for parents to access immunization services. Expanding the scope of practice is one way to meet this challenge – say, for example, by allowing pharmacists to obtain parental consent and administer vaccines to children. This could be particularly helpful in areas that lack convenient access to caregivers.

14 Arguably, the strength of these recommendations would increase if healthcare professionals themselves were better at following immunization guidelines for annual influenza vaccines. See the Appendix for a discussion of healthcare workers and vaccination policy.

15 The Canadian Paediatric Society (MacDonald and Finlay 2013, 1) recommends "staying on message and using clear language to present evidence of disease risks, and vaccine benefits and risks fairly and accurately; informing parents about the rigour of the vaccine safety system; addressing issues related to pain from immunization; and avoiding dismissal of children from a practice because parents refuse to immunize."

But there are downsides to consider as well. Health professionals might not be adequately trained to inform parents about the benefits and costs of decisions, or might provide information that is inconsistent with that provided by other sources. As parents interact with a larger group of healthcare professionals, this increases the risk that they might become confused by conflicting information. It further increases the risk of data errors and duplication among providers, especially without a proper electronic registry. Thus, a proper electronic registry seems a necessary first step.

One area where scope of practice has played a big role in changing care choices for new parents is midwifery, and vaccination policies must keep pace with this change. Midwives today play a greater role in the birthing and post-birth process than in the recent past, and there are good reasons to believe that they attract patients who are wary about common medical practices. It follows, therefore, that midwives should be included in discussions of how best to provide information on the benefits and risks of vaccines, and to do so in a manner consistent with that of other health professionals.[16]

Research has found that midwives are less likely than physicians to recommend immunization and frequently make no recommendation at all, suggesting that more could be done to support them in helping their clients make a fully informed choice (Dubé et al. 2013). Further, midwives could play a greater role in post-birth follow-up to administer vaccines, with scheduled visits that coincide with the first round on the immunization schedule.[17] There is considerable potential for midwives to support the immunization process, particularly since their clients are already more likely to be vaccine-hesitant. But their role and responsibilities in the process must be clear, and education about vaccines and training on how to disseminate information is required.

Understanding how different messages affect the immunization decision is essential. Recent research suggests that people interpret data more clearly when provided with probabilities in the form of frequencies, such as 1 out of 1,000, instead of percentages (0.1 percent). The difference might appear subtle, but multiple studies have shown dramatic improvements in the ability of laypeople and experts to work with probabilities when they are presented in this format (Gigerenzer and Hoffrage 1995; Hoffrage et al. 2000). Policymakers could also reduce the number of attributes to be considered in a single decision, labelling numbers with a qualitative judgment such as "poor" and using visual representations (Peters 2012). Numerous past efforts, at different levels of government and health region, have been made to improve the presentation of information to parents (see, for example, Derban et al. 2013; MacDonald and Finlay 2013). These efforts need constant revision and should be better coordinated and consistent in the future.

Another issue is the difficulty of assessing the immunization status of immigrants, including authenticating documentation from the country of origin. Here, cooperation between the federal department of citizenship and immigration and provincial health authorities would be helpful. Once immigrants have been granted landed status in Canada, they should be required to meet with a provincial health agency to discuss immunization. The Canadian Immunization Guide notes that "more than one-third of new immigrants and refugees, particularly women, were susceptible to measles, mumps, or rubella" (Greenaway et al.

16 Some studies have pointed out the importance of engaging midwives in provincial vaccination frameworks; see, for example, Lee et al. (2005).

17 Midwives currently are able to administer a vaccine to a child in Ontario, but not in Alberta.

2007), and it suggests that physicians should assume newly arrived immigrants who lack documentation of their vaccination status are unvaccinated and recommend the full vaccination schedule.[18] Similarly, immigration reception centres should be encouraged to provide information about immunization, which might help reach particularly vulnerable immigrants. Newfoundland and Labrador, for example, has a full-time public health nurse attached to the St. John's community centre for new immigrants – the Association for New Canadians – and one of the roles is to ensure immunizations of new arrivals are up to date. Mandated choice in schools could also help address potential coverage issues for the children of immigrants.

One final policy lesson is obvious: the need for better data collection. We cannot improve what we cannot measure. Better recording of data would allow for early, carefully targeted interventions and better coverage of interprovincial migrants and immigrants. A good start is the Panorama System that Ontario and several other provinces are currently implementing to help track immunization rates and combat communicable diseases.

But Panorama does not electronically record vaccinations at the time they are administered, and does not track adult immunizations – even though it has the capacity to do – implying that the data will remain inconsistent (Ontario 2014a).

Conclusion

The low immunization coverage ratios in some regions of Canada are a major health concern. Research tells us that people might ignore costs and benefits that occur well into the future. Arguably, the general societal expectation in Canada is that people will get vaccinated, but barriers to access and the complexity of the decision mean that parents without a family physician, those in low-income households, single parents and new arrivals in Canada are particularly vulnerable to not immunizing their children.

The difference in outcomes between Alberta and Newfoundland and Labrador, despite their reasonably similar vaccination policy programs, suggests that population density and immigration can make a large difference to the effectiveness of a given model. Even small changes in how a policy is carried out can affect results, as with the high levels of partially vaccinated children in Alberta. Nevertheless, a few key lessons for the design of the Canadian immunization system can be drawn.

Getting immunized should be as easy as possible. A comprehensive registry to coordinate reminders, automatic enrolment at birth and working with parents pre-birth to ensure they are comfortable with immunization could help reduce the difficulty of making the decision. Moreover, making the decision should be compulsory. Mandated choice, at school entry or earlier, is an effective way to compel parents to make the vaccination decision without forcing strongly opposed parents to immunize against their will. The process should require that parents actively opt out of getting their child vaccinated, making it more likely that the default choice is to get immunized. Financial incentives, while a blunt instrument, also might be an effective option, especially if other approaches are failing.

Finally, how information about immunization is provided – particularly statistical information, but including all information relevant to the decision – is critical, as clear messages can make a large difference to immunization coverage. A national or cross-province registry would help identify low-coverage areas and vulnerable communities, and

18 One reviewer suggested that religious leaders could also play a greater role as advocates of vaccination programs or as helpful facilitators to encourage their community to get in touch with local health professionals.

ensure that the system does not miss interprovincial migrants and immigrants.

We believe that vaccination policies could be improved to better accommodate parents while still accommodating choice. In particular, we believe that public health bodies and healthcare providers should focus on delivering information about the benefits and risks of vaccinations to support decisionmaking, especially for vaccine-hesitant parents, and on gathering information about who is immunized and who is not. The policy process is not just a matter of informing parents, but also of making sure they are involved in the decisionmaking process and feel they have the information and tools they need to make the right decision.

APPENDIX: HEALTHCARE WORKERS AND ANNUAL INFLUENZA VACCINES

Many of the vaccination problems that relate to child immunization also apply to influenza coverage of adults and health workers.[19] The Association of Medical Microbiology and Infectious Disease Canada therefore has encouraged making influenza vaccines mandatory for healthcare workers (AMMI 2012; see also Bryce et al. 2012; Flegel 2012). In 2012, British Columbia passed legislation requiring any unimmunized healthcare worker to wear a mask during flu season, and Saskatchewan announced in 2014 it would do the same. Some doctors argue that remaining unimmunized places patients at risk, and so immunization is the responsibility of any healthcare professional. Unions and other opponents point out that the influenza vaccine is generally estimated to have 60 percent effectiveness, and that such policies violate freedom of choice. Thus, governments, while eager to encourage immunization among healthcare workers, are uncertain about whether to make it mandatory.

This challenge, like that relating to children, could be alleviated by addressing some of the reasons for under immunization. Some studies suggest that many healthcare workers do not get immunized because vaccines are not easily available or because they forget (Christini, Shutt, and Byers 2007; Hauri et al. 2006), and so an essential step would be to ensure that the immunization process is simple. Immunization should be done in the workplace, making it hard to forget and eliminating commute and planning costs. As well, like the use of gloves, the process should become as routine as possible for healthcare workers. Similar to Ontario school immunization, freedom of choice could be preserved by requiring healthcare workers actively to choose whether or not to be immunized when they arrive at work, rather than allowing them to passively procrastinate on making the decision.

Some Canadian healthcare bodies have also begun messaging campaigns to convince healthcare workers to immunize. It is important that these be designed well. Positive messaging about the benefits to patients can be more effective than negative messaging that warns healthcare workers they could be suspended from work without pay in the event of an outbreak or shaming those who do not get vaccinated (Lugo 2007). Other methods, such as pointing out that other healthcare workers get immunized and emphasizing the importance of basic infection control, also might be effective, as would presenting statistical information as frequencies, rather than as probabilities. That said, none of these measures is likely to increase immunization rates among healthcare workers to 100 percent; if that is the policy goal, then the only option might be legislation.

19 The median rate of influenza immunization among healthcare workers in Toronto in 2012–13 was 47 percent in acute care facilities and 76 percent in long-term care homes, comparable to Ontario-wide healthcare worker rates (Toronto 2013). Experimental trials have found that influenza immunization in long-term care homes can reduce mortality in these facilities by 20 to 40 percent during the influenza season (Bryce et al. 2012; Carman et al. 2000).

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